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by

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A recurring theme in naval debate since the mid-19th century has been the vulnerability of warships in the face of the threats posed by new weapons. In their day Sinope, Hampton Roads, Lissa, Tsushima, and Jutland focused the attention of the public, as well as professional opinion, on the subject. World War II and the development of nuclear weapons rekindled this interest. From a historical perspective this interest appears to have been most keen during a conflict following an extended period of peace during which there was rapid development in naval weapons technology. Against this background, the quest for "lessons learned"—or relearned—from the Falkland episode of last year should not come as a surprise.

Ship sinkings in combat are dramatic events that capture the public imagination. Such sinkings, as during the Falkland campaign, are particularly dramatic to a public with a foreshortened historical perspective. The vulnerability of naval and sealift forces to air and submarine attack would not have surprised those sailors who journeyed to Malta, Murmansk, or Okinawa some forty years ago. Similarly, the capabilities of naval forces to isolate a battlefield or interrupt its lines of communication would not have surprised the sailors, soldiers, and marines on either side of Bataan, Singapore, Saipan, or Inchon. Although surprises may be few for the professional observer with a longer perspective of the development of naval warfare, that is not to say that a fundamental shift in the balance of ship vulnerability has not occurred since the last major conflict—even if one puts nuclear weapons effects aside. Since recent data points are few, the Falkland experience offers a timely opportunity to review the enduring issue of surface ship survivability.

Survivability is not simply a question of proper ship construction, the effectiveness of the installed weapons, and damage control training. Survivability is critically related to the mission given to the ship in a particular situation and to her tactical employment in conjunction with other weapons. For example, the mission given the ship may not be the one for which she was built. Sailors, just as soldiers and airmen, must fight with what they have. In other cases a ship may be given a mission for which she was

constructed, but the enemy may be so numerous and capable that her survivability is questionable in any event. In either case, a well-constructed and well-trained ship may be deployed at long odds (perhaps as a result of combat necessity) and be placed at serious risk. The point is that ship vulnerability must be appraised in a broad context that goes beyond hardware and training factors.

To a large degree this broader context is defined by the capabilities of the adversary actually encountered. The adversary may be somewhat different from that envisioned when the ship was designed. This broader context is also defined by one's own strategy and tactics in countering those capabilities to achieve an objective.

The lengthy lead times involved in ship procurement and the long service life of the average warship make ship design a high-risk art form as well as a science. Every ship is a bundle of compromises among weight, speed, usable payload, seaworthiness, and so on. Entwined with these performance compromises, are compromises on cost. At some point a government faces the decision of buying a set number of ships at a given cost, or more ships for the same cost. Implicit, if not obvious, in these decisions are issues of ship survivability and judgments on the risks and acceptability of losses.

Of necessity a ship embodies the technology that existed at the time she was built. While updates are routinely conducted, the ship's future capabilities are largely defined by decisions made at the drawing board. There are, of course, exceptions. Older platforms have been modified successfully to support new missile and aircraft systems. However, major changes in power plant installation, size (which in large measure defines ship survivability and the types of weapons and sensors that can be accommodated), and seaworthiness can only be backfitted with great difficulty. There are not many successful examples.

It is against this complex backdrop of mission, tactical employment, design performance, and cost tradeoffs that we must assess the potential survivability of today's surface ships and the implications for future ship and naval force design and employment. This examination will focus on two sets of assessments:

- The current balance between the offense and the defense at sea.[1]
- Available alternatives to redress real or perceived imbalances.

These assessments will focus on combat with nonnuclear weapons. But, many of the points made and the judgments offered apply equally to combat with nuclear weapons. With the use of such weapons the price paid for errors in system design and operation increase enormously. However, in most cases a ship can only be sunk once. Effective action taken to counter or avoid the first salvo (or near miss in the case of nuclear weapons) has a potentially high payoff in terms of survival.

The Offensive-Defensive Balance

Until the Falkland campaign of last year, there had been no major naval combat since 1945. Naval forces had been involved in combat operations—but usually in direct support of a land campaign and with little naval opposition. This long period without major naval combat operations and the coincident sweeping changes in naval technology have resulted in considerable professional interest in the current state of the offensive-defensive balance. To better understand this balance, we should review the way matters stood at the conclusion of the last major naval conflict.

At the end of World War II the offense and defense could be considered in rough balance, a balance based on:

- Recognition that naval surface forces must be covered by friendly air power when facing an opposing air power.
- The inherent speed and endurance limitations of the air-breathing submarine compared to most warships.
- The importance of the volume of gun, torpedo, and bomb firepower in destroying the enemy.

Undergirding this balance was the prevalent scheme of naval architecture that placed major emphasis on survivability by means of a combination of armor, compartmentation, system redundancy, and on damage control procedures written in blood. Since 1945 the following major trends have disturbed the balance.

- The use of nuclear propulsion in major units—particularly submarines.
- The introduction of precision-guided weapons that embody a trend from firepower volume to precise fire control.
- The conversion to much faster, longer ranged, and more nimble aircraft.
- The major role of electronics for detection, localization, defense, and command and control.
- The gradual, but nonetheless pronounced, decreased emphasis on armor, redundancy, and compartmentation in ship design.

Most naval professionals agree that the net effect of these trends has been a clear superiority of the offense—principally because of the revolution in the capability of nuclear-powered submarines and the combination of fast aircraft and smart missiles. To survive against an opponent with such forces, the surface ship must have, or be supported by, a first-class ASW capability, and an effective fighter-shipboard missile-gun air defense team. To employ surface units without those capabilities against a well-armed enemy is to court naval disaster in the foreseeable future. Indeed, these requirements for defensive capabilities have become so stringent that most naval professionals believe that no single type of ship (e.g., surface combatants) can do the job by itself.

Lacking such capabilities, a nation concerned with ship survivability and naval effectiveness must pick its opponent, allies, tactics, and the locus of its operations very carefully. Even with such care, it will require very flexible multimission ships, skillful crews and commanders—and luck. These elements were all present to Britain's advantage in the Falkland episode.

If one viewed Rear Admiral John Woodward's offensive mission last spring as putting the landing force ashore in the Falkland Islands and providing them support, one could view his defensive mission as one of protecting the fleet and the forces ashore from air and naval attack. Naval interest in the Falkland campaign has centered on the defensive mission, particularly on air defense of the British fleet and on neutralization of the Argentine fleet.

The Argentine Air Force and naval air units were not first-class opponents in spite of the skill and bravery of their flight crews. Their deficiencies in equipment, weapons, and (at least initially in) tactics have been widely reported. To balance this offensive deficiency, the British task force did not have a first-class air defense capability. Its deficiencies in early warning, surface-to-air missile system suitability, and interceptor aircraft are also well known. Underlying these deficiencies were questions on the ability of the British ships to withstand damage.

In the event, the Argentine air forces ran out of aircraft and crews before Britain ran out of a willingness to sacrifice its ships. Given the limitations of the scenario and the adversaries, what can be said about surface ship survivability from this experience?

- First, the *Belgrano* experience confirmed what was well known: surface forces—particularly those without a first-class ASW capability—are at serious risk in combat with nuclear-powered submarines. How the British force would have fared, if opposed by one or more nuclear-powered submarines, is an interesting question. While such capabilities as the task force had were first class, it lacked others needed to confront a modern and capable opponent. Deficiencies included an almost total absence of support by long-range maritime air and fixed or towed passive sonar arrays. Additionally, one suspects that assigned SSNs or embarked ASW helicopters were given duties that were at times inconsistent with the mission of detecting and destroying enemy submarines. Speculation aside, the Falkland campaign does not add to our knowledge about the survivability of modern surface forces against attack by modern submarine forces.
- The lessons to be relearned from the British fleet air defense experience were known to most naval professionals beforehand: modern air defense requires a combination of effective early warning, air interceptor, and point defense capabilities. Here, the enormous handicaps faced by the British task force—little, if any early warning, make-do interceptors, and gaps in point defense capabilities—were only just acceptable because of the limited

capabilities of the opponent. The modest—but sufficient—nature of British success in dealing with the threat merely emphasizes the gap between flawed force capabilities and the requirements associated with confronting an opponent more capable than Argentina was.

• The record on individual ship survivability revealed some unpleasant surprises. Ship losses tend to clarify one's thinking about the importance of building after-hit survivability into a ship. The effects of a generation of emphasis on fire power and fire control at the expense of damage control in a design-to-cost environment stood exposed to daily headlines. The nature of the losses themselves revealed the price paid for building ships too small to include adequate system redundancy. Survivability may have been the hidden variable in peacetime shipbuilding programs.[2] However, the case can be overstated. Except for the *Sheffield*, the escorts sunk were the object of multiple bomb hits. Historically, few ships of their size have fared much better under such punishment.

To sum up the applicability of the Falkland experience to an assessment of ship survivability, there seem to be lessons relearned rather than learned. The experience makes it less convenient to ignore the expensive and unpleasant realities of building survivable naval forces. The lessons relearned are worth relearning because of the very large naval construction programs and force expansions now underway in the Soviet Union and the United States. However, in the larger sense, the Falkland experience has dramatized the increasing gap between the offense and the defense in naval warfare. Such drama is often needed to prompt change. We shall now turn to an examination of alternatives that have been offered to respond to the imbalance and their effect on surface ship survivability.

Redressing the Balance

While there is general agreement that the advantage rests with the offense in naval conflict, there is less agreement on the implications for warship construction and naval force design. This lack of agreement has blossomed into a lively and high stakes debate in the United States where the controversy often centers on the survivability of the necessarily scarce large-deck aircraft carrier compared to that of large numbers of smaller ships.[3] Most of the debate, in the United States and elsewhere, has been on force balance, or increasing pre-hit survivability, rather than on ship design practices for increasing post-hit survivability. The Falkland experience has done much to balance the dialogue, but most advocates remain more interested in force structure than warship design.

In the current state of surface warship survivability, the alternatives offered include:

• Leave the naval battle to submarines and land-based air power. This school believes that surface ship survivability is so low that the war at sea

should be waged principally by other means. This rather extreme argument with the technology of an earlier generation was put to the test by Nazi Germany in World War II. It may appeal to this or the next Soviet generation. However, as a prescription for the West, it overlooks the asymmetries in Western and Soviet dependence on sea lines of communication. This alternative does not contain a credible basis for prescribing Western naval force structures unless one is planning for a war that is so short that sea lines of communication do not play a part.

- Rely on big deck aircraft carriers, or land-based air in narrower seas, to provide the capabilities necessary to supplement the limited and incomplete set of capabilities provided by surface and subsurface forces. The Falkland episode illuminated the risks of deploying forces not equipped with big-deck carriers in an area where supporting land-based air power could not be brought to bear.
- Rely on an increased number of smaller missile armed ships to both supplement and complement existing large carrier capabilities. The argument is based in part on increasing the number of aim points the opponent must contend with and in part on hedging against the loss of carriers that currently carry almost all the conventional power projection capabilities and most of the air defense capabilities of US naval forces. Much of the dialogue about the "lessons learned" from the Falkland experience has centered on the utility of this alternative. Depending on the point of view, that experience "proved" the necessity of big-deck carriers (to avoid the small ship losses suffered by the Royal Navy), or alternatively, the vulnerability of surface ships (e.g., carriers) and the need to put one's eggs in many baskets. While both cases may have been "proved" in the Falkland environment, it is by no means clear that either is decisive in structuring forces for an ultimate shoot-out with the Soviets.
- Rely on new technology for a dramatic improvement in ship performance. This interest has centered on hydrofoil and air-cushion technology with much larger platforms than currently in use. Some see utility in the application of "stealth" technology (reducing visual and electromagnetic observables) to surface vessels. Others see the potential of greater utilization of V/STOL vehicles on surface ships for improving their defensive capabilities. While there is a temptation to dismiss the potential for practical application of such technology, it is sobering to recall how submarine technology was changed forever during the decade of 1945-1955. The side with the first 70-knot missile-armed destroyer may dominate naval events in some future decade.
- Improve the surface ship's ability to survive hits (or near misses in the nuclear context). This alternative seems favored by all—at least until the price to be paid is identified in terms of budget costs, firepower sacrificed, crew comfort degraded, etc. While there are some short-term remedies,

most will require action during design and construction; major changes in compartmentation, propulsion redundancy, and materials employed are seldom feasible once the keel is laid.

Each of these alternatives has merit. The research, development, and construction programs of the Soviet Union and the United States will contain a mixture of all. Smaller, less wealthy nations of necessity will settle for less, and thereby tailor their naval programs and commitments accordingly.

Implications

The issue of surface warship survivability has been dramatized but not decided by the Falkland experience. However, based on that experience, it is clear that a naval campaign between well-armed opponents will be very costly in terms of surface ship losses (and aircraft losses for that matter). Measures to reduce losses include putting forces to sea that have improved pre-hit survivability in the form of balanced modern defenses and post-hit survivability in the form of increased resistance to crippling damage. If such measures are not available, the nation concerned must pick its theater of combat and its opponent very carefully, or plan to employ its forces under the cover of an ally with the necessary capabilities.

The pre-hit survivability issue will likely continue to revolve around the role of air power (whether land or carrier-based) in support of surface warships. The evidence is not entirely clear that surface warships can survive even with good air support, but it is clear that against a first-class opponent they cannot survive long without it. Even such capable weapons as the Aegis missile system in the USS *Ticonderoga* can be overwhelmed by massive, consecutive attacks unless paired with other means of large-area defense (fighters in today's environment).

The implication of this judgment is: without carriers or other seaborne means of providing large area defense, naval forces fighting a first-class opponent must be operated under an umbrella of land-based air coverage. In view of stated Soviet aims for global projection of power, the future development of a Soviet carrier capability beyond the *Kiev* class should come as no surprise. For Britain the requirement for large area air defense coverage in the face of a first-class opponent means that future naval combat operations must be either in close proximity to Britain itself (or other suitable bases), or against second-class opponents, or in close coordination with US naval forces.

A review of the professional literature over the past ten years leaves the impression that the threat posed by the nuclear-powered submarine to surface forces exceeds the air threat in gravity. But the critical fact in threat assessment is that few nations can pose a major submarine threat to surface forces, while many can pose a credible air threat. In any event, the pre-hit survivability of naval forces in the face of nuclear-powered submarine

opposition is an issue that has not been resolved—or even illuminated by the Falkland experience. But aside from that experience, it is becoming clear that without a balanced first-class ASW capability in support, surface warships are not survivable when exposed to attack by nuclear-powered submarines. Those powers with nuclear-powered submarines appear to hold the ultimate weapon in naval conflicts with lesser powers who, for the most part, place little emphasis on antisubmarine warfare.

The importance of post-hit survivability appears to be a lesson for all nations who rely on naval power. The US Navy is fast becoming a force with over half of its escorts propelled by a single shaft each—a decision made almost solely on cost rather than survivability considerations. The British experience in the Falkland campaign highlighted other design compromises for whch a heavy price has been paid. Soviet ships rely heavily on topside ammunition stowage that is vulnerable to detonation by even minor fragment damage.[4] These trends portend a series of naval disasters in future high intensity naval conflicts.

Some Conclusions

This cursory tour of the ship survivability issue suggests that major changes are required in naval force commitment policies, force structure, tactical doctrine, technology application, and ship construction. The increasing advantage enjoyed by the offense since World War II probably can be remedied only by revolutionary changes.

Force Commitment Policies. The "near run thing" aspects of the Falkland campaign, in the context of pre-conflict planned reductions in the Royal Navy, suggests that there needs ro be a clear linkage between foreign policy and naval force structure. The decreased survivability of surface forces—even against lesser powers—lends urgency to this requirement. In some cases this will mean cutting back on traditional and hallowed commitments. In other cases, vigor will be required to build up a survivable force structure to fit the policy.

Force Structure. Survival of surface forces hinges on adequate air defense and ASW capabilities. Missile ships, even if very capable, must be complemented by other means of area defense when facing a modern air threat. Modern ASW requires a multi-platform, multi-sensor force to counter the threat posed by nuclear-powered submarines. These capabilities are expensive and therefore out of reach of most naval powers. Accordingly, such powers will be obliged to consider forces that can only be effective in certain areas, against selected opponents, or with certain allies. They must structure their naval forces to be supported by land-based air power that can be used for other purposes as well (e.g., homeland air defense and tactical air support of

ground forces). In addition those powers will be forced to rely to a major degree on land-based air power and their allies for fleet defense against submarines. These conclusions have an important impact on tactical doctrine.

Tactical Doctrine With naval forces relying increasingly on the support of other services and other nations, doctrine that stops at national or service boundaries is outmoded. In order to survive, even major modern navies will require assistance, beyond what was previously the self-contained naval task force.[5] The emerging view of the necessity of employing "combined arms" in the naval sense should in turn develop changes in current training and tactical doctrine.

Technology Application. The offense at sea is sufficiently ahead of the defense that the time is at hand for major changes in force characteristics. While recognizing that such changes take time, there is precedent for rapid changes. The conversion to all-big-gun battleships in the decade before World War I, the massive US carrier-building program during World War II, and the shift to nuclear power in submarines in the decade after World War II suggest that if the incentive is great enough, major changes can be reflected rapidly in force structure. The time appears ripe for naval statesmen to increase their efforts to harness technology to the defense by accepting more technical risk. The speed conferred by hydrofoil and air-cushion technology could do much to reduce the submarine threat, while electronics technology still has enormous potential to reduce the air threat.

Ship Design and Construction. While design and construction are tied closely to emerging technologies, there are tradeoffs within existing technology that can be made to increase ship post-hit survivability. The Falkland backdrop has provided a healthy exposure of some current deficiencies and may assist naval architects in being heard when the time for weapons-ship structure tradeoffs are made. Clearly, those who make today's decisions on ship characteristics must provide greater system redundancy, fire resistance, and armor protection than their predecessors had given.

To summarize, surface warships are not survivable against a well-equipped opponent unless certain minimum capabilities are provided. These capabilities are increasingly difficult to provide and innovative solutions to the problem will be required if surface warships are to continue to perform traditional naval missions.

NOTES

1. The terms offense and defense, as used in the discussion to follow, refer to the attacker and the defender in a given tactical situation.

2. This is not a new lesson. Battle cruiser performance at Jutland and American aircraft carrier and cruiser performance in 1942 were in part the result of peacetime design compromises driven by cost, treaty, or flawed tactical doctrine. Naval professionals, in their zeal to get the most fire power afloat in the most ships possible, are not without blame in trading off the less easily measured capabilities of platform survivability. Until losses are experienced, survivability appears chiefly to be the narrow concern of the naval architect or (theoretically in peacetime) the commanding officer who may be obliged to hazard his ship in combat.

3. In general, proponents of a larger number of smaller ships (or the same number of smaller ships with greater capabilities) do not argue against the need for the big-deck carrier. Rather, they say that such carriers should be supplemented by distributing more of the offensive capabilities of a naval force to smaller (and perhaps more numerous) platforms.

4. See James W. Kehoe et al., "U.S. and Soviet Ship Design Practices, 1950-1980," US Naval Institute *Proceedings*, May 1982, pp. 118-134, for a discussion of the advantages and disadvantages of this and other Soviet design practices that affect survivability.

5. The US Navy reached agreement with the US Air Force last year in defining (or confirming) the Air Force role in naval warfare. While there have been some differences in the interpretation of this agreement (as to whether it is a logical continuation of previous agreements or represents a departure from or enhancement of previous policies), the decision to publicize the agreement probably represents a commitment by the Navy to emphasize greater USN-USAF coordination in naval operations. The Air Force's AWACs, tankers, tactical aircraft, and heavy bombers can make a major contribution in the prosecution of a naval campaign. The additional capabilities provided should ultimately enhance surface ship survivability. One must understand the depth of naval feeling about the importance of self-contained capabilities and centralized command of naval forces to appreciate the importance of any increase in the Navy's willingness to share its sea control mission with another service.

Rear Admiral Winnefeld has served on a destroyer, cruiser, battleship, and numerous aircraft carriers and amphibious ships. His last sea assignment was as Commander, Amphibious Squadron Two.